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National Pathfinder Survey of 12-Year-Old Children's Oral Health in Italy

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Key Words

Dental caries, 12-year-olds $\boldsymbol{\cdot}$ Epidemiological study $\boldsymbol{\cdot}$ National survey, Italy

Abstract

No recent data on the experience of caries among Italian 12year-olds are available. In 2004, an epidemiological survey called 'National Pathfinder among Children's Oral Health in Italy' was promoted and carried out. This study reports the actual oral health status of Italian 12-year-olds according to gender, residence area and geographical distribution. Clinical examinations were carried out from March 2004 to April 2005, according to WHO criteria, and included dental caries (decay at the dentinal lesion level) and Community Periodontal Index (CPI). 5,342 children (2,670 males, 2,672 females) were examined by 7 ad hoc calibrated raters. Dental caries experience was found in 43.1% (95% CI 41.8-44.4%) of the study population. The mean DMFT score was 1.09 (95% CI 0.98–1.21). Significant differences (p<0.05) were observed among geographical sections for DT, FT and DMFT. An inverse relationship was observed between mean DMFT and gross national product per capita (p < 0.001). Gingival bleeding was observed in 23.8% of children, while 28.7% had calculus. Significant differences in CPI scores among sections were found throughout the sample in both males and females (p < 0.001). Over the past two decades, mean DMFT fell from over 5 to its present level, halving every decade;

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Fax +41 61 306 12 34 E-Mail karger@karger.ch www.karger.com © 2007 S. Karger AG, Basel 0008-6568/07/0416-0512\$23.50/0 Accessible online at: www.karger.com/cre consequently, the recorded level of dental caries has become aligned with that in other Western European countries. Nevertheless, differences in DMFT values remain between children from different socioeconomic backgrounds. Copyright © 2007 S. Karger AG, Basel

Over the past two decades, the prevalence of caries in the populations of Western industrialized countries has decreased markedly. Several authors have reported that the prevalence of dental caries has also decreased in children [WHO, 1997; de Almeida et al., 2003; Marthaler, 2004; Bratthall, 2005; Petersen and Christensen, 2006; Pitts et al., 2006]. The reasons for this decline are various and complex, but the most important are widespread use of fluoridated toothpastes [Moynihan and Petersen, 2004], a more sensible approach to sugar intake, and knowledge about the importance of oral hygiene in oral health maintenance, mainly acquired from the mass media, especially in countries such as Italy where no schoolbased preventive programs have been established. The decline in dental caries experience can also be ascribed to changes in diagnostic criteria and to preventive and restorative efforts by dental health services [Chen et al., 1997].

The prevalence of dental caries can be related to ethnicity, income, educational level of parents, etc. Several studies [Sundby and Petersen, 2003; Jacobsson et al.,

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2005; Skeie et al., 2006] have revealed a relatively high prevalence in children from underprivileged socioeconomic backgrounds.

WHO [WHO, 1997] recommend national epidemiological surveys to monitor oral health status in specific age groups. Twelve-year-olds are especially important as a target group for evaluating the level of dental caries among children with permanent teeth and they are often chosen for international comparison.

In Italy, only a few epidemiological surveys have been conducted on small samples of 12-year-old children [Angelillo et al., 1998; Brambilla et al., 1999; Campus et al., 2001, 2005]. A multicentric cross-sectional survey conducted in three Italian areas reported an average DMFT of 5.33 [Vogel et al., 1986]. In 1996, the first national survey reported a DMFT value of 2.12 [WHO, 1997]. Since then, no new data have been recorded at a national level. In fact, the prevalence of caries in Italy is not known, although there are reports that the prevalence of the disease has decreased [Brambilla et al., 1999; Campus et al., 2001, 2005].

In 2003, an epidemiological survey called 'National Pathfinder among Children's Oral Health in Italy' was promoted by the Collaboration Centre for Epidemiology and Community Dentistry of Milan in collaboration with the Italian Society of Hygiene and Preventive Medicine. The aim of the survey was to evaluate the prevalence of dental caries and periodontal conditions in 12-year-olds.

The present study describes the actual oral health status of Italian children aged 12 years according to gender, residence area and geographical distribution.

Materials and Methods

In 2004 the population of Italy was 58,462,375 (28,376,804 males and 30,085,571 females) of whom 14.2% were less than 15 years old. Expectancy of life at birth was 77.1 years for males and 82.8 years for females. The gross national product (GNP) per capita is EUR 19,676.70. The ratio of dentist to inhabitants is 1:1,124.

The present study was carried out as a cross-sectional survey from March 2004 to April 2005. The design of the study was approved by the Research Ethics Committee of the University of Milan in December 2003. A multistage cluster sampling was performed, considering the Italian sections according to the National Institute of Statistics classification as strata: North-Western, North-Eastern, Central, Southern and Insular Italy [ISTAT, 2004]; in the second stage the counties of the sections and then the secondary schools were chosen at cluster level with proportional random selection of participants. A sample size for each stratum was calculated based on an assumed prevalence of dental caries (DMFT >0) of 45%, a standard error of 0.05 and design effect of 2.5 [Lwanga and Lemeshow, 1991]. A total number of about 6,000 Italian children attending the first grade of secondary schools was estimated for the final sample. This strategy provided a sample that was self-weighting.

The tap water fluoride content in the different areas selected for the survey varied from 0.02 to 0.4 ppm [Ministero Italiano dell'Ambiente, http://www.minambiente.it].

Parents or guardians were issued with an information leaflet explaining the aim of the study and requesting their child's participation. Children were enrolled as participants only with their parents' signed consent. In total, 5,611 children were recruited and 5,342 were examined, 2,670 males and 2,672 females; 208 children, with no parents' signed consent and 61 not present in the classroom at the moment of the examination were excluded.

Data were collected in the schools by means of clinical examinations. The following clinical conditions were recorded: (a) dental caries experience (DMFT) was recorded with decay at the dentinal lesion level [Pitts and Longbottom, 1995], using a plain mirror (Hahnenkratt, Königsbach, Germany) and the WHO Community Periodontal Index (CPI) ballpoint probe (Asa-Dental, Milan, Italy) under artificial light; (b) CPI (score 0: healthy; score 1: gingival bleeding at probing; score 2: calculus). Significant Caries Index was calculated too [Bratthall, 2000; Campus et al., 2003]. Due to the high number of children to visit, the number of examiners was set at 7. In order to avoid the intercluster variability attributable to interexaminer variability, each selected school was visited by all 7 raters at the same time and each examiner visited an equal proportion of subjects. The team received training and interexaminer reliability was assessed before the start of the study; sensitivity, specificity, percentage agreement and kappa statistics were recorded. Percent agreement ranged from 98.0 to 99.2% and kappa statistics ranged from 0.92 to 0.97 [Castiglia et al., 2007].

The GNP per capita was used as a measure of welfare and the mean GNP for each area was recorded.

Gender and ethnic background were recorded as part of the clinical examination. Ethnicity was defined as the country of birth of the parents. People born in Italy and Europe were treated as one group because they were considered similar in cultural background. Residence area was included in the survey, as a proxy of urbanization, it was stated on subjective judgment by children's parents regarding the area of residence of the households (urban or rural).

The frequency of caries was expressed as a proportion. Frequency distributions and means of DMFT were calculated for geographical sections, gender and residence areas. The CPI data were analyzed according to WHO recommendations, whereby participants were categorized by maximum CPI score.

The Wald test was used to compare the mean estimates between gender in different sections. The Kruskal-Wallis test was used to evaluate differences among means. Independence between categorical variables was evaluated with a χ^2 test. A linear regression model was built up between DMFT and GNP per capita for each geographical area as a proxy variable for socioeconomic status. At an individual level, the relationship between DMFT and calculus, a proxy variable for low oral hygiene status, was evaluated using multiple regression analysis by gender. The covariates in the regression model were the numbers of sextants with calculus and the average GNP per capita. The level of significance was set at 0.05 for all statistical analyses. The data were processed and analyzed using STATA 9 software [Stata, 2005].

Italian sections	DT (95% CI)	FT (95% CI)	MT (95% CI)	DMFT (95% CI)
North-Western	0.58 (0.42-0.75)	0.38 (0.26-0.50)	0.02 (0.01-0.03)	0.99 (0.81-1.16)
Males	0.47 (0.35-0.59)	0.38 (0.24-0.53)	0.02 (0.00-0.03)	0.87 (0.73-1.01)
Females	0.70 (0.47-0.92)	0.39 (0.25-0.52)	0.02 (0.01-0.04)	1.11 (0.87-1.36)
p value ¹	0.01	0.95	0.24	0.02
North-Eastern	0.52 (0.35-0.69)	0.42 (0.29-0.56)	0.01 (0.00-0.01)	0.95 (0.84-1.06)
Males	0.38 (0.28-0.49)	0.42 (0.30-0.54)	0.01 (0.00-0.02)	0.81 (0.72-0.91)
Females	0.65 (0.39-0.91)	0.43 (0.25-0.61)	0.003 (0.00-0.01)	1.08 (0.87-1.30)
p value ¹	0.011	0.86	0.11	0.037
Central	0.72 (0.55-0.89)	0.36 (0.26-0.45)	0.02 (0.02-0.03)	1.10 (0.88-1.32)
Males	0.68 (0.52-0.84)	0.31 (0.23-0.39)	0.01 (0.00-0.02)	1.00 (0.79-1.21)
Females	0.76 (0.57-0.95)	0.41 (0.29-0.52)	0.03 (0.02-0.05)	1.20 (0.95-1.45)
p value ¹	0.14	0.01	0.086	0.005
Southern	1.13 (0.84-1.41)	0.35 (0.19-0.50)	0.02 (0.00-0.03)	1.50 (1.07-1.92)
Males	1.17 (0.84-1.50)	0.28 (0.14-0.42)	0.02 (0.00-0.04)	1.47 (1.02-1.92)
Females	1.08 (0.84-1.50)	0.42 (0.25-0.58)	0.02 (0.00-0.03)	1.52 (1.09-1.94)
p value ¹	0.36	0.0001	0.99	0.59
Insular Italy	0.58 (0.47-0.70)	0.31 (0.16-0.45)	0.03 (0.00-0.05)	0.92 (0.68-1.15)
Males	0.48 (0.31-0.66)	0.27 (0.09-0.44)	0.03 (0.01-0.05)	0.77 (0.43-1.11)
Females	0.69 (0.51-0.88)	0.35 (0.21-0.49)	0.03 (0.00-0.07)	1.07 (0.84-1.31)
p value ¹	0.12	0.25	0.82	0.01
Total Italy	0.71 (0.62-0.80)	0.36 (0.31-0.42)	0.02 (0.02-0.03)	1.09 (0.98-1.21)
Males	0.65 (0.56-0.74)	0.33 (0.27-0.38)	0.01 (0.01-0.02)	0.99 (0.87-1.11)
Females	0.77 (0.67-0.87)	0.40 (0.33-0.47)	0.03 (0.02-0.03)	1.20 (1.06-1.33)
p value ¹	0.003	0.004	0.10	0.0001

Table 1. Survey estimation of means and 95% CI of DMF(T) index by gender and Italian sections adjusted for design effect

¹Adjusted Wald test.

Results

Overall, 43.1% (95% CI 41.8–44.4%) of the children had dental caries, 40.5% of the males and 45.6% of the females (p < 0.001). The percentages of caries-free subjects in the different geographical sections were: 59.7% in North-Western, 59% in North-Eastern, 57.5% in Central, 46.7% in Southern Italy and 60.6% in Insular Italy. Less than 4% of the subjects had one or both parents born outside Europe.

Table 1 displays survey estimations of means and 95% confidence intervals of DMF(T) index by gender and Italian sections adjusted for design effect.

Overall the national mean DMFT was 1.09 (95% CI 0.98–1.21), ranging from 0.92 (95% CI 0.68–1.15) in Insular Italy to 1.50 (95% CI 1.07–1.92) in Southern Italy. The D component of the caries index was dominant everywhere. Kruskal-Wallis test showed significant differences among sections for DT (p = 0.003), FT (p = 0.004) and DMFT (p = 0.0001). Figure 1 displays the distribution of the DMFT index for the whole sample; the index was posi-

tively skewed in all sections. The national mean (\pm SD) of the Significant Caries Index was 2.99 \pm 1.75 (2.76 \pm 1.67 in males, 3.22 \pm 1.79 in females) (p < 0.05; data not in table).

There were no significant differences in the caries data with respect to urban or rural residence, nor to ethnicity, even though caries experience was higher in non-European ethnicity children (DMFT: 1.20 vs. 1.0; p = 0.31) (data not in table).

GNP per capita was significantly inversely related to mean DMFT (p < 0.001) (fig. 2). Table 2 shows the results concerning periodontal conditions. Almost a quarter of the participants (23.8%) had gingival bleeding, while 28.7% had calculus. CPI scores were statistically different among different sections of Italy (p < 0.001) and between males and females (p < 0.001). Figure 3 shows the results of the multiple regression model: the relationship between DMFT and the number of sextants with calculus by gender is displayed. The fitted values of DMFT means were higher in females than males.

Italian sections	Healthy n (%)	Bleeding n (%)	Calculus n (%)
North-Western	473 (53.1)	196 (22.0)	222 (24.9)
Males	239 (52.4)	102 (22.4)	115 (25.2)
Females	234 (53.8)	94 (21.6)	107 (24.6)
North-Eastern	377 (55.7)	150 (22.2)	150 (22.2)
Males	167 (50.6)	69 (20.9)	94 (28.5)
Females	210 (60.5)	81 (23.3)	56 (16.1)
Central	1,066 (45.8)	618 (26.6)	642 (27.6)
Males	497 (43.1)	311 (27.0)	346 (30.0)
Females	569 (48.6)	307 (26.2)	296 (25.3)
Southern	292 (38.8)	182 (24.2)	279 (37.1)
Males	133 (35.5)	79 (21.1)	163 (43.4)
Females	159 (42.1)	103 (27.3)	116 (30.7)
Insular Italy	330 (48.0)	122 (17.8)	235 (34.2)
Males	162 (45.9)	53 (15.0)	163 (39.1)
Females	168 (50.3)	69 (20.7)	97 (29.0)
Total Italy	2,538 (47.6)	1,268 (23.8)	1,528 (28.7)
Males	1,189 (44.9)	614 (23.0)	856 (32.1)
Females	1,340 (50.3)	654 (24.5)	672 (25.2)

Table 2. Distribution of 12-year-old Italian children by maximumCPI score

Test of independence (CPI and Italian sections): total sample $\chi^2_{(8)} = 90.05$, p < 0.001; males $\chi^2_{(8)} = 65.58$, p < 0.001; females $\chi^2_{(8)} = 38.14$, p < 0.001.

Discussion

The aims of preventive dentistry are to plan and build up strategies for promoting dental health, especially in children and adolescents, to provide guidelines on schemes and methods for this to dental personnel, and to react to changes brought by new diagnostic methods and treatment designs. To achieve these objectives in practice it is necessary to have epidemiological data on oral health for the country in which preventive dentistry is to be performed. Furthermore, the Italian health care system has been in transition during recent decades. The primary dental health service is based on private health care providers; thus, oral care is mainly financed by direct payment by the patient or, to a lesser extent, through public or private insurance schemes.

Thus, our study was intended to assess the oral status of Italian 12-year-olds. Several points were chosen in different geographical sections in order to provide data representative of the entire nation. The level of dental caries recorded in Italian 12-year-olds is quite low; in fact, the caries experience is very close to the value fixed by WHO



Fig. 1. Frequency (bars) distribution of DMFT for whole sample (normal probability shown by solid line).

Fig. 2. Relationship between mean DMFT and GNP per capita. **Fig. 3.** Relationship between DMFT and the number of sextants with calculus by gender, using multiple regression model.

as the goal for 2010 (i.e. DMFT <1). In a European perspective, the Italian results are comparable to those described in other Western European countries [WHO, 1997; Marthaler, 2004], where there are well-organized public oral health services for children and adolescents [Sundby and Petersen, 2003; Pitts et al., 2006]. Moreover, the mean DMFT value in Italy is lower than those reported by authors in other European countries where oral health care systems are similarly limited [de Almedia et al., 2003; Demertzi et al., 2006]. These figures might confirm that dental services have a limited role in the decrease in caries levels of 12-year-olds whereas broad socioeconomic factors and the widespread use of fluoridated products are the main factors [Nadanovsky and Sheiham, 1994, 1995]. Nevertheless, significant differences in DMFT values were noted among geographical sections. In particular, Southern Italy showed a DMFT near 60%, which is higher than in the two Northern sections. This disease pattern is probably correlated with the socioeconomic status of the population: people living in Southern Italy, where GNP pro capita is significantly lower than in other parts of Italy, have less access to dental care and consequently a higher level of disease. However, the D component was dominant in all geographical regions, indicating a need for dental care and a lack of control over the disease.

In Italy, as reported above, only limited data are available on the prevalence of caries. The present survey reports further improvement of dental caries among 12year-olds. Over the past two decades, the mean DMFT fell dramatically from over 5 [Vogel et al., 1986] to approximately 2 in 1996 (WHO) and then to the present level, halving every decade. This change is similar to that reported in other Western countries [Marthaler, 2004]. It remains to be seen whether the decline of caries in Italy will reach a plateau, as has been found in Nordic countries [Haugejorden and Birkeland, 2002].

Few data are available in the literature on gingival conditions of 12-year-olds. The present survey reported a high level of gingival bleeding and calculus in Italian children; only half the sample was healthy, showing the need for improvement in self-care oral hygiene. Nevertheless, the CPI maximum score in Italy was significantly better than that recorded for Portuguese 12-year-olds in 2003 [de Almeida et al., 2003].

An inverse clinical relationship between the presence of calculus and caries has been proposed. This would imply that the absence of calculus could be a useful predictor of caries. The literature gives few and contradictory data on this topic, and a very weak inverse correlation between supragingival calculus and caries has been reported [Manji et al, 1989; Pattanaporn and Navia, 1998; Duckworth and Huntington, 2005]. Our data failed to support the hypothesis that children with calculus had less caries than children without calculus.

In conclusion, the oral health situation of Italian 12year-old children seems to have improved over the past few decades; the level of dental caries has become aligned with that in other Western European countries, even though no school-based promotion or preventive programs have been established at a national level. Nevertheless, differences in DMFT values remain between children from different socioeconomic backgrounds. Efforts should be made to improve oral hygiene practice and to reduce dental caries through preventive programs, especially at school level in Southern Italy, where the disease remains out of control.

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